National Institute of Environmental Health Sciences

Possible impacts of climate change on extreme weather events at local scale in south-central Canada

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Abstract:

Synoptic weather typing and regression-based downscaling approaches have become popular in evaluating the impacts of climate change on a variety of environmental problems, particularly those involving extreme impacts. One of the reasons for the popularity of these approaches is their ability to categorize a complex set of meteorological variables into a coherent index, facilitating the projection of changes in frequency and intensity of future daily extreme weather events and/or their impacts. This paper illustrated the capability of the synoptic weather typing and regression methods to analyze climatic change impacts on a number of extreme weather events and environmental problems for south-central Canada, such as freezing rain, heavy rainfall, high-/low-streamflow events, air pollution, and human health. These statistical approaches are helpful in analyzing extreme events and projecting their impacts into the future through three major steps or analysis procedures: (1) historical simulation modeling to identify extreme weather events or their impacts, (2) statistical downscaling to provide station-scale future hourly/daily climate data, and (3) projecting changes in the frequency and intensity of future extreme weather events and their impacts under a changing climate. To realize these steps, it is first necessary to conceptualize the modeling of the meteorology, hydrology and impacts model variables of significance and to apply a number of linear/nonlinear regression techniques. Because the climate/weather validation process is critical, a formal model result verification process has been built into each of these three steps. With carefully chosen physically consistent and relevant variables, the results of the verification, based on historical observations of the outcome variables simulated by the models, show a very good agreement in all applications and extremes tested to date. Overall, the modeled results from climate change studies indicate that the frequency and intensity of future extreme weather events and their impacts are generally projected to significantly increase late this century over south-central Canada under a changing climate. The implications of these increases need be taken into consideration and integrated into policies and planning for adaptation strategies, including measures to incorporate climate change into engineering infrastructure design standards and disaster risk reduction measures. This paper briefly summarized these climate change research projects, focusing on the modeling methodologies and results, and attempted to use plain language to make the results more accessible and interesting to the broader informed audience. These research projects have been used to support decision-makers in south-central Canada when dealing with future extreme weather events under climate change.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES)

Special Report on Emissions Scenarios (SRES) Scenario: SRES A2, SRES B2

Exposure :

weather or climate related pathway by which climate change affects health

Air Pollution, Extreme Weather Event, Temperature

Air Pollution: Ozone, Particulate Matter, Other Air Pollution

Air Pollution (other): CO; NO2; SO2

Extreme Weather Event: Flooding, Other Extreme Event

Extreme Weather Event (other): Freezing Rain

Temperature: Extreme Heat

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Non-U.S. North America

Health Impact:

specification of health effect or disease related to climate change exposure

Morbidity/Mortality

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction, Outcome Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Long-Term (>50 years)